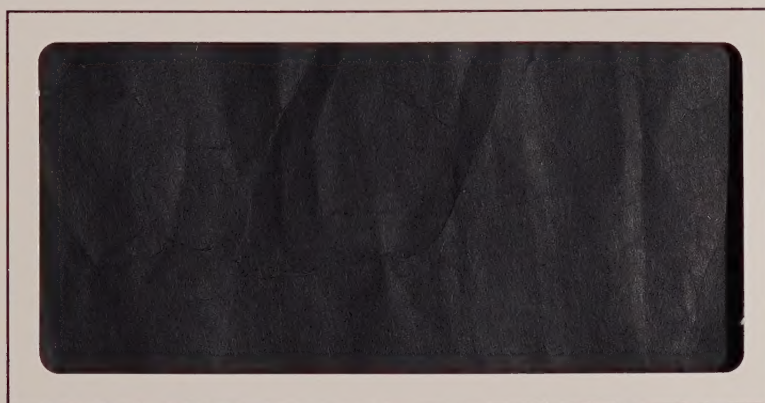




WAVETEK®



OPERATOR'S MANUAL

Model 680-01

20 MHz Arbitrary Waveform Generator

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WAVETEK®

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680 Manual Set

680 Standard Manuals

	Operator's			Maintenance				
	General Description	Installation	Operation	Theory of Op	Calibration	Trouble-shooting	Schematics	Parts Lists
Mainframe	Mainframe Operator's Manual			Mainframe Maintenance Manual				
Arb Gen	Arb Operator's Manual			Arb Maintenance Manual				
Timing Gen	TGen Operator's Manual			TGen Maintenance Manual				
Pulse Gen	PGen Operator's Manual			PGen Maintenance Manual				
DMM	DMM Instruction Manual							
Counter	1993 Counter Instruction Manual							

680 MATE Manuals

	Operator's			Maintenance				
	General Description	Installation	Operation	Theory of Op	Calibration	Trouble-shooting	Schematics	Parts Lists
Mainframe	Mainframe Operator's Manual			Mainframe Maintenance Manual				
Arb Gen	Arb Operator's Manual			Arb Maintenance Manual				
Timing Gen	TGen Operator's Manual			TGen Maintenance Manual				
Pulse Gen	PGen Operator's Manual			PGen Maintenance Manual				
DMM	(Contained in Standard DMM Instruction Manual)							
Counter	(Contained in Standard 1993 Counter Instruction Manual)							

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SAFETY FIRST



PROTECT YOURSELF. Follow these precautions:

- Don't touch the outputs of the instrument or any exposed test wiring carrying the output signals. This instrument can generate hazardous voltages and currents.
- Don't bypass the power cord's ground lead with two-wire extension cords or plug adaptors.
- Don't disconnect the green and yellow safety-earth-ground wire that connects the ground lug of the power receptacle to the chassis ground terminal (marked with  or ).
- Don't hold your eyes extremely close to an rf output for a long time. The normally nonhazardous low-power rf energy generated by the instrument could possibly cause eye injury.
- Don't plug in the power cord until directed to by the installation instructions.
- Don't repair the instrument unless you are a qualified electronics technician and know how to work with hazardous voltages.
- Pay attention to the **WARNING** statements. They point out situations that can cause injury or death.
- Pay attention to the **CAUTION** statements. They point out situations that can cause equipment damage.

1

SECTION GENERAL DESCRIPTION

1.1 GENERAL DESCRIPTION (MODEL 680-01)

Model 680-01, 20 MHz Arbitrary Waveform Generator, seen in figure 1-1, generates arbitrary waveforms up to 12 bits of vertical resolution and 12k horizontal resolution, and function generator waveforms of sine, triangle, ramp, square, dc and their inverse. These function generator waveforms are permanently stored in ROM.

Operation modes include: continuous, triggered, gated and burst.

1.2 CAPABILITIES

The Arbitrary Waveform Generator module programmable waveform capabilities are shown in table 1-1.

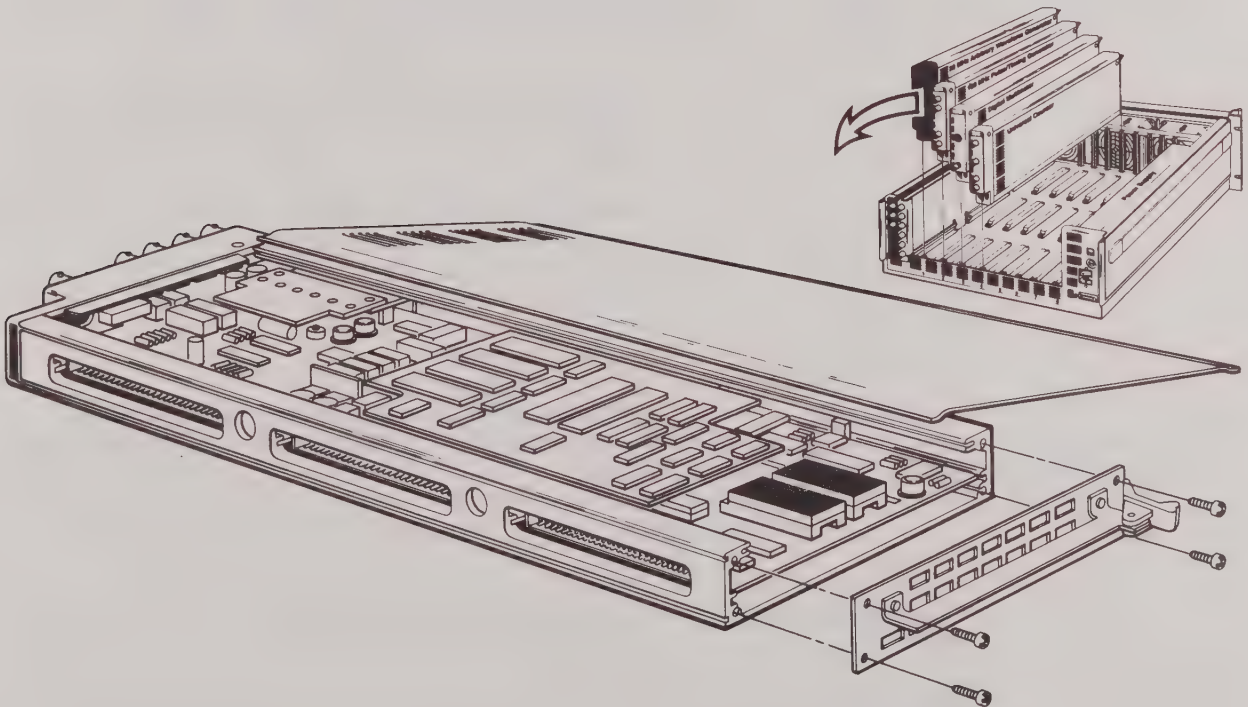


Figure 1-1. The Model 680-01 20 MHz Arbitrary Waveform Generator Module

Table 1-1. Arbitrary Waveform Generator Capabilities

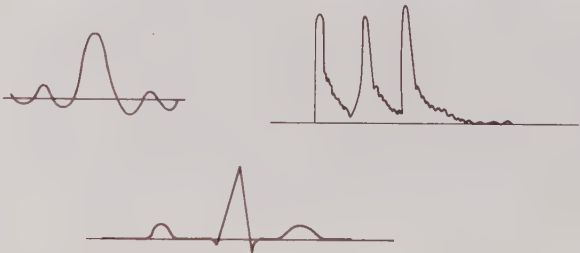
Category	Capability	Description
Arbitrary Waveforms	Ten waveforms	Up to ten arbitrarily defined waveforms can be stored for generation. The user defines the waveform length and shape. For example; the three shown below can be programmed.
		
Standard Waveforms	Five types	Sine, square, triangle, sawtooth and DC signals can be generated. The polarity and number of repetitions can be selected.
Waveform Controls	Timing	The output waveform frequency, clock source and the number of times that a waveform is to be repeated are all programmable.
	Filtering	The output waveform can be filtered, if desired. The user may select low pass filtering at 0.1 MHz or at 4.0 MHz.
	Levels	The output voltage levels can be user defined.
	Waveshape	User programmable
	Duty Cycle	The ramp and square wave signals from the standard function generator may be programmed for variable duty cycles.
	OFF/ON Control	The ARB OUT output can be turned on or off by a control relay.
	Impedance Adjust	A user defined value can be selected. The module can also measure the attached load impedance and set the internal impedance.
	Summing	The output signal of the Arbitrary Waveform Generator may be summed to the system analog sum bus (ANASUM), the system analog bus (ANASUM) can be summed to the Arbitrary Waveform Generator output, or summing be disabled.

Table 1-1. Arbitrary Waveform Generator Capabilities (Continued)

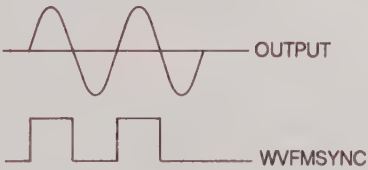
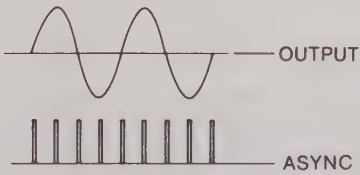
Category	Capability	Description
Output Modes	Continuous	Output waveforms can be generated continuously.
	Triggered	A single cycle of a user selected waveform can be generated on the event of a valid selected trigger. The 680 System trigger (STRIG), the External Trigger (TRIG IN), or the 680 System Sync signal (SSYNC) are selectable trigger sources.
	Gated	A user selected waveform can be generated continuously only while the trigger input is high.
	Burst	A waveform can be generated a programmable number of times.
Arb Out Output (BNC Connector)	Arbitrary Waveform Generator signal output	This output is the module output for connection to external devices.
WVFMSync Output (BNC Connector)	Arbitrary Waveform Generator synchronization output	This output generates a synchronization pulse at the beginning of each waveform period. The waveforms below show the timing relationships for these two signals. 
Arbsync Output (BNC Connector)	Arbitrary Waveform Generator synchronization output	This output can be programmed to generate synchronization pulses at any point(s) within an output waveform. The waveforms below show one of the timing relationships of this feature.  Only applies to user defined (arbitrary) waveforms.

Table 1-1. Arbitrary Waveform Generator Capabilities (Continued)

Category	Capability	Description
Clock In Input (BNC Connector)	Clocking from an external source	An external clock can be selected instead of the internally generated clock, allowing exact synchronization of generated waveforms with external sources. (Only applies to user defined waveforms.)
Trig In Input (BNC Connector)	Triggering from external source	This external trigger input can be used to trigger events inside the Arbitrary Waveform Generator.
Miscellaneous module outputs	System synchronization	A synchronization pulse can be generated to the SSYNC bus at the beginning of each waveform or at any point(s) desired during the waveform or this feature can be disabled so that no synchronization pulses are generated at any time. (Any point applies to user defined waveforms only.)
	Amplitude modulation	Any Timing Generator installed in the 680 can be amplitude modulated by the output of an adjacent Arbitrary Waveform Generator.

1.3 SPECIFICATIONS

1.3.1 Arbitrary Characteristics

Horizontal Resolution: 12k points.

Vertical Resolution: 12 bits (–2047 to 2047).

Waveform Memory: Stores up to 10 waveforms with user defined length from 8 points to memory maximum.

Arb Clock

Sampling Frequency (clock): 1 MHz to 20 MHz.

Resolution: 4 digits or 1 mHz.

Waveform Repetition Rate: 2.5 MHz (clock/No. of waveform points).

Accuracy: 5 ppm.

Stability: 2 ppm in 10 min., $\pm 3^{\circ}\text{C}$.

1.3.2 Functions

Function Generator Mode: Sine, Triangle, Ramp, Square, DC and the inverse of all waveforms.

Arbitrary Generator Mode: Sin(x), Cos(x), Exp(x), Sin(x)/x and user defined.

Operational Modes: Continuous, Triggered, Gated and Burst.

Burst: Programmable from 1 to 65,535.

Sine Distortion

10 μHz to 99.9 kHz: <0.2%.

To 100 kHz: <0.7%.

No harmonics above –40 dBc

100 kHz to 4 MHz.

Square Transition Time: 50 Ω into 50 Ω , <25 ns.

Square Aberrations

<10 Vp-p: $\pm(5\% + 20 \text{ mV})$.

>10 Vp-p: $\pm(10\% + 20 \text{ mV})$.

Duty Cycle: (Square and ramp) 0.1% to 99.9%. Square defaults to 50% above 1 MHz.

1.3.3 Frequency

Range

Sine: 10 μHz to 4 MHz.

Square: 10 μHz to 10 MHz.

Triangle/Ramp: 10 μHz to 250 kHz.

Resolution: 4 digits or 10 mHz.

1.3.4 Amplitude

Range: 10 mVp-p to 20 Vp-p into 50 Ω load.

Resolution: 1 mV to 10 mV depending upon range.

Accuracy

Into 50 Ω , 0.1% load.

10 to 20 Vp-p: $\pm 1\%$ of programmed value +5 mV.
1 to 10 Vp-p: $\pm(1\% + 5\text{ mV})$.
0.1 to 1 Vp-p: $\pm(2\% + 2\text{ mV})$.
10 to 100 mVp-p: $\pm(3\% + 0.5\text{ mV})$.

Frequency Response

Range	Response	Filter On
100 μ Hz to 9.999 kHz	$\pm 1\%$	100 kHz
10 kHz to 49.999 kHz	$\pm 3\%$	100 kHz
50 kHz to 0.9999 MHz	$\pm 5\%$	4 MHz
1MHz to 4MHz	$\pm 10\%$	4 MHz

1.3.5 Offset

Range

For given offset range, minimum amplitude must be:

Offset	Min. Ampl. (volts peak)
5.001 to 10 Vdc	>0.52
0.501 to 5 Vdc	>0.26
51 to 500 mVdc	>0.026
5 to 50 mVdc	>0.002

Programmable Load Impedance

(Enter mode. This applies for use of loads other than 50 Ω .)

Range: 25 to 1k Ω .

Accuracy: $\pm 5\%$.

1.3.6 DC Voltage Accuracy

DC Function Accuracy

Into 50 Ω , 0.1% load.

5.001 to 10 Vdc: $\pm(1\% + 40\text{ mV})$.

0.501 to 5 Vdc: $\pm(1\% + 40\text{ mV})$.

51 to 500 mVdc: $\pm(2\% + 10\text{ mV})$.

5 to 50 mVdc: $\pm(3\% + 3\text{ mV})$.

Resolution: 1 mV from lowest to highest range.

1.3.7 Outputs

Function Output, Waveform Sync Output, and Arbitrary Sync Output.

1.3.8 Inputs

Trigger Input and External Clock.

1.3.9 Internal I/O

System Trigger Bus, System Sync Bus, Analog Summing Bus and Pulse Amplitude Modulation (PAM source for Timing Generator).

1.3.10 General

Stored Settings: Provided by chassis. There are 99 stored settings that can be divided between the chassis and modules to meet user needs.

Environment: Refer to chassis specifications.

Dimensions: 15.9 cm (6.25 in.) high, 41.9 cm (16.5 in.) long, 3.0 cm (1.2 in.) wide.

Weight: 1.8 kg (4 lb) net.

Power: <32W.

1.3.11 Option

010: MATE-CIIL Interface

2

SECTION INSTALLATION

2.1 INTRODUCTION

This section provides receiving, inspection, installation, confidence test and operation familiarity procedures for the Model 680-01 Arbitrary Waveform Generator.

2.2 RECEIVING INSPECTION

Check the shipment at the time of delivery and inspect each box for damage. Describe any box damage and list any shortages on the delivery invoice.

2.3 UNPACKING INSTRUCTIONS

1. **Unpack the boxes.** Unpack the boxes in a clean and dry environment. Save all the packing materials in case the instrument has to be returned for repair.
2. **Inspect the shipment for damage.** Inspect the equipment carefully for any signs of mechanical damage regardless of the condition of the shipping boxes.
3. **If necessary, file a damage claim.** In the case of mechanical damage, call the shipper immediately and start the claim process.
4. **Call Wavetek.** Call Wavetek's Customer Service Department (619-279-2200) to inform them that the shipment arrived damaged. Please be prepared to provide a detailed damage report.

2.4 RETURNING EQUIPMENT

Follow these steps when you return equipment to Wavetek:

1. **Save the packing material.** Always return equipment in its original packing material and boxes. If you use inadequate material, you'll have to pay to repair any shipping damage as carriers won't pay claims on incorrectly packed equipment.
2. **Call Wavetek Customer Service and ask for a return authorization.** Wavetek Customer Service representative (619-279-2200) will ask for your name, telephone number, company name, equipment type, and a description of the problem.
3. **Pack and ship the equipment.**

2.5 MECHANICAL INSTALLATION

The following steps describe how to install modules into the Model 680 mainframe chassis.

1. Remove the three screws from the rear of the 680 top panel and then slide the panel back and off.
2. Place the module into the channel slots as illustrated in figure 2-1*. When inserting the module into the slots ensure the module guides slide into the top chassis alignment guides at either end of the module. Before setting the module in its channel slot visually verify correct positioning.

2.6 CONFIDENCE TEST AND OPERATION FAMILIARITY

The Confidence Test and Operation Familiarity Procedure tests the operation of the module. It can be used for two purposes:

1. **Receiving Checkout.** The incoming inspection department should run this procedure to verify that the module works properly. This procedure verifies that it has not received shipping damage.
2. **New Operator Training.** Operators unfamiliar with the Model 680 can use this procedure to learn the basic operation of the controls.
This procedure takes about 15 minutes (not including hookup time).

2.6.1 Required Test Equipment

Table 2-1 lists the required test equipment. Manufacturer and/or model numbers are not given; any general purpose test equipment meeting the specifications shown can be used.

2.6.2 Procedure

Table 2-2 steps through the Confidence Test and Operation Familiarity procedure.

2.6.3 Test Record

Table 2-3 can be used to record a permanent record of the instrument test.

**If the installation requires Pulse Amplitude Modulation (PAM) of a Pulse/Timing Generator module, the Arb must be installed next to the Pulse Timing Generator and in the low numbered slot (For example, slot 1 of adjacent slots 1 and 2.) Blank modules must be used in nonfunctional slots for bus continuity, radiation control and air path control, as seen in figure 2-2.*

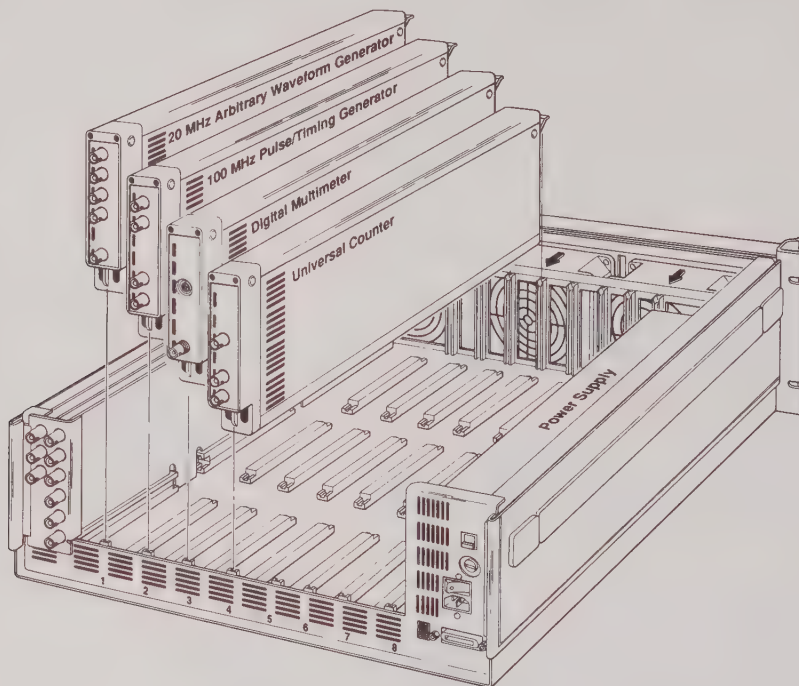


Figure 2-1. Module Installation

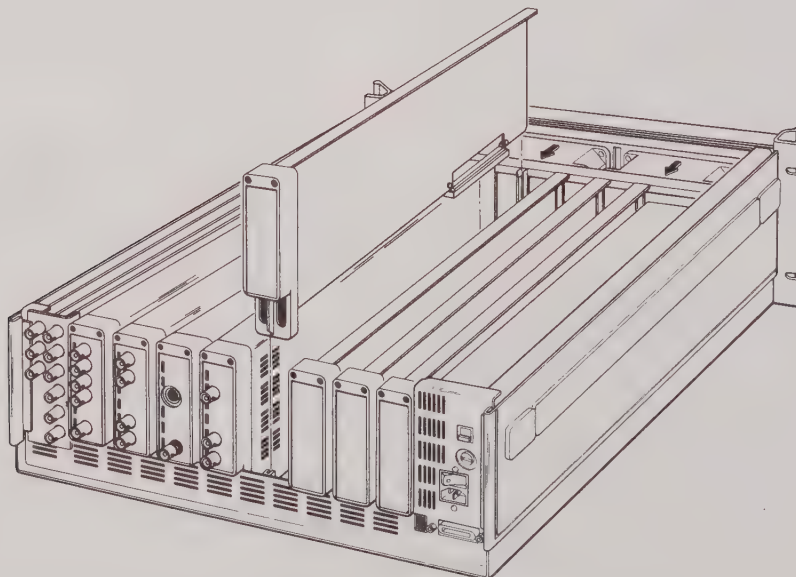


Figure 2-2. Example of Blank Module Placement

Table 2-1. Required Test Equipment

Equipment	Qty	Specifications
Oscilloscope	1	Dual channel. Vert Sens: 10 mV to 5V/DIV. Horiz Swp: 5nS to 1 Sec/DIV. Input Imp: $\geq 1\text{ M}\Omega$ or 50Ω . Bandwidth: $\geq 100\text{ MHz}$, $\geq 300\text{ MHz}$ preferred.
Terminations	3	BNC feedthrough. 5W 50Ω impedance (75 or 93Ω opt.)
Coaxial Cables	3	One meter lengths. BNC male on both ends. RG-58/U type, 50Ω (75 or 93Ω opt.).
Signal Generator	1	1 MHz minimum. Output: 50Ω , 5 Vp-p minimum. Output Connection: BNC. Required Function: Squarewave.

Table 2-2. Confidence Test and Operation Familiarity Procedure

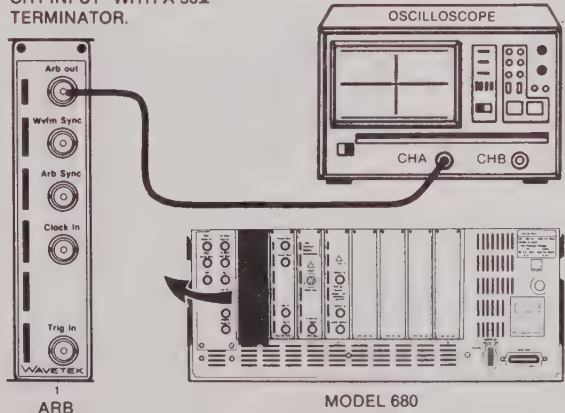
Step	Action	Test Setups or Action Response
1	Turn the 680 POWER switch to the STANDBY position.	SET TRIGGER TO INTERNAL, CH 1 SWEEP TO 0.2 mS/DIV AMPLITUDE TO 1.0V/DIV  TERMINATE THE OSCILLOSCOPE CH1 INPUT WITH A 50Ω TERMINATOR. 1 ARB MODEL 680 CAUTION If the 50Ω loads are omitted in the oscilloscope connections, any amplitude value entered under 10Vp-p will be inaccurate and read twice the value called for in the procedure. Any amplitude over 10Vp-p into an unterminated circuit will cause the output to rise to a high level and possibly damage equipment under test.
2	Connect the 680 to the test equipment shown.	

Table 2-2. Confidence Test and Operation Familiarity Procedure (Continued)

Step	Action	Test Setups or Action Response
3	Turn the 680 POWER switch to the ON position. Run Autocal and Selftest.	(See sections 3.3.5 and 3.3.6 for details)
4	Press the MODULE SELECT key. The display will list all of the modules positions and will indicate which type of module occupies each position.	1: 20 MHz ARB 2: TIMING GEN sys 3: 4: 5: 6: 7: 8:
5	Press the Numeric key that corresponds to a 20 MHz ARB.	m3 -arbitrary waveform generator (VX.X.X)- arbgcn funcgcn output trig sync sum
6	Press the Output key (F3) to call the module output control menu.	m3 -----output----- -----internal----- off on impd on off
7	Press the On key (F2) to close the module output relay. The signal appearing on the oscilloscope shows the power up settings of the module. Once the output is turned on, a 1KHz sine wave can be seen on the oscilloscope display. This is the default setting of the arb.	output 1 m3 -----output----- -----internal----- off ON impd on off The oscilloscope shows a sine wave with a period of 1.0ms. The vertical scale is marked with 2V and 0V. The wave oscillates between approximately 1V and -1V relative to the 0V reference. Oscilloscope

Table 2-2. Confidence Test and Operation Familiarity Procedure (Continued)

Step	Action	Test Setups or Action Response
8	Press the Module Menu key to call the module menu. The two main sections of the arb. are the function generator and arbitrary waveform generator. Steps 9 through 25 will discuss how the different function generator selections can be used to create a waveform while step 26 through 39 explain how the arb. can be used to create an arbitrary waveform.	<pre> m3 -arbitrary waveform generator (VX.X.X)- arbgen funcgen OUTPUT trig sync sum </pre>
9	FUNCTION GENERATOR Press the Funcgen key F2 to call the Function Generator control menu.	<pre> m3 ----- function generator ----- timing level mode func filter </pre>
10	Press the Timing key F1 to call the timing control menu.	<pre> m3 ----- timing ----- freq period burst cnt duty </pre>
11	Press the Freq key F1 so that the module output frequency can be programmed.	<pre> frequency: 1.000 kHz m3 ----- timing ----- FREQ period burst cnt duty </pre>
12	On the Numeric keypad, key in the following sequence: 10 Exponent 3 Execute .	<pre> frequency: 10.00 kHz m3 ----- timing ----- FREQ period burst cnt duty </pre>
13	Press the Module Menu key to call the module menu.	<pre> function generator m3 -arbitrary waveform generator (VX.X.X)- arbgen FUNCGEN output trig sync sum </pre>

Table 2-2. Confidence Test and Operation Familiarity Procedure (Continued)

Step	Action	Test Setups or Action Response
14	Press the Funcgen key F2 to call the Function Generator control menu.	m3 ---- function generator ---- TIMING level mode func filter
15	Press the Level key F2 so that the module output voltage levels can be programmed.	m3 --- level --- --- function --- ampl ofst - normal invert
16	Press the Ampl key F1 so that the module output amplitude can be set.	m3 amplitude: 2.000 Vpp --- level --- --- function --- AMPL ofst - normal invert
17	On the numeric keypad, key in the following sequence: 5 Execute .	m3 amplitude: 5.000 Vpp --- level --- --- function --- AMPL ofst - normal invert
18	Press the Ofst key F2 so that the output voltage offset can be programmed.	m3 offset: 0.000 V --- level --- --- function --- ampl OFST - normal invert
19	On the numeric keypad, key in the following sequence: 2 Execute .	m3 offset: 2.000 V --- level --- --- function --- ampl OFST - normal invert
20	Press the Module Menu key to call the module menu.	m3 -arbitrary waveform generator (VX.X.X)- arbgen FUNCGEN output trig sync sum
21	Press the Funcgen key F2 to call the Function Generator control menu.	m3 ---- function generator ---- timing LEVEL mode func filter

Table 2-2. Confidence Test and Operation Familiarity Procedure (Continued)

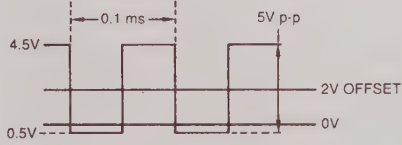
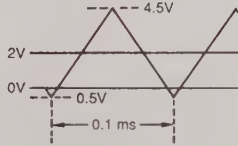
Step	Action	Test Setups or Action Response
22	Press the Func key F4 to call the function selection menu.	m3 <pre> --- function generator functions --- sine tri square ramp dc </pre>
23	Press the Square key F3 to select a squarewave at the output.	m3 <pre> ----- function generator ----- timing level mode FUNC filter </pre>  Oscilloscope
24	Press the Func key F4 to call the function selection menu.	m3 <pre> --- function generator functions --- sine tri SQUARE ramp dc </pre>
25	Press the TRI key F2 to select a triangle wave at the output of the module.	m3 <pre> ----- function generator ----- timing level mode FUNC filter </pre>  Oscilloscope
26	ARBITRARY WAVEFORM GENERATOR Press the Module Menu key to call the module menu.	m3 <pre> -arbitrary waveform generator (VX.X.X) arbgen FUNCGEN output trig sync sum </pre>

Table 2-2. Confidence Test and Operation Familiarity Procedure (Continued)

Step	Action	Test Setups or Action Response
27	Press the arbgen soft key F1 to call the arbitrary waveform generator control menu. (The waveform on the oscilloscope's display being generated by the function generator will now disappear since funcgen has been deactivated)	-----arb waveform----- select define edit - control m3
28	The three step procedure used to generate an arbitrary waveform will be: a. Select a waveform number. b. Set the waveform size c. Input data points per address.	
29	Press the Select key F1. (This key is used to select one of a possible 10 arbitrary waveforms in memory or to assign a number to a new waveform. If a waveform has not been selected, a -1 will be displayed.)	waveform #: -1 ---waveform--- ---memory--- wvfm# size delete status m3
30	Press wvfm# key F1. Enter 1 execute.	waveform #: 1 ---waveform--- ---memory--- WVFM# size delete status m3
31	Press size key F2. Enter the points size of the arbitrary waveform. For example, for a 1000 point waveform, press the keys 1 0 0 0 execute.	wvfm size = 1000 (length = 1000) ---waveform--- ---memory--- wvfm# SIZE delete status m3

Table 2-2. Confidence Test and Operation Familiarity Procedure (Continued)

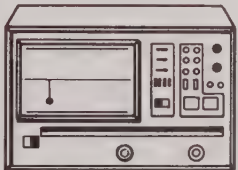
Step	Action	Test Setups or Action Response
32	To enter the data points, back out of this menu by pressing the module Menu key. Then press ARBGEN key F1 .	
33	This will return you to the arb waveform menu as seen opposite.	m3 <pre> ----- arb waveform ----- SELECT define edit - control </pre>
34	Press the edit key F3 .	m3 <pre> ----- modify ----- adrs data async vector draw </pre>
35	Press the adrs key F1 and then press 0 execute . You are now at address 0 of a 1000 address waveform.	m3 <pre> address: 0 data: 0 ----- modify ----- adrs data async vector draw </pre>
36	Data can now be entered at address 0. This is achieved by pressing data key F2 and then entering the data value for this address, for example - 2 0 4 7 execute .	m3 <pre> data: -2047 address: 1 ----- modify ----- adrs DATA async vector draw </pre>
37	Looking at the oscilloscope's display, you will notice this first entry point at the lowest negative value.	

Table 2-2. Confidence Test and Operation Familiarity Procedure (Continued)

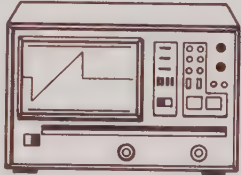
Step	Action	Test Setups or Action Response
38	The address will automatically increment and so the data to define our point to point waveform can be entered by simply pressing the second data value, the third data value, the fourth data value, and so on until all points have been entered and finally an execute .	
39	The vector soft key selection F4 can be used to join two specified data points. For example, at adrs (F1) 0 execute enter a data (F2) value of - 2 0 4 7 and at adrs (F1) 2 5 0 enter a data (F2) value of + 2 0 4 7 and then press the vector key F4 . This will produce a ramp waveform as seen opposite.	

Table 2-3. Module Operation Test Record

Step	Desired Results/Limits	Test Results
7	The Arb Out output shall be a 1 kHz sine wave of 1 Vp-p amplitude.	
23	The Arb Out output shall be a 10 kHz square wave of 5 Vp-p amplitude whose offset is 2V.	
25	The Arb Out output shall be a 10 kHz triangle wave of 5 Vp-p amplitude whose offset is 2V.	
39	The arbgen can be used to create a waveform	

3.1 INTRODUCTION

The Model 680-01 Arbitrary Waveform Generator can be either locally operated from the front panel controls (Section 3.2) or remotely operated by an instrumentation controller (Section 3.3).

3.2 THE FRONT PANEL MODULE KEYS

The following section describes in detail all of the function module keys. To see how all of these keys can be used to create a waveform with the function or arbitrary waveform generator, refer to the operation familiarity procedure in section 2.6.

3.2.1 Universal Module Keys

1. **Select** Key (Figure 3-1)

Control of individual modules begins by pressing the **Select** key. Use it to gain access to a particular option module menu. The display will list all of the module positions and will indicate which modules are in which positions. Empty module positions are indicated by blanks after the corresponding number. Use the numeric keypad to select a module menu.

2. **Quick Cal** Key

Pressing the **Module Quick/Cal** key will produce an error message stating that no quick/cal is available for this module.

3. **Manual Trigger** Key

The **Module Manual Trigger** Key provides a valid trigger input to any selected module. When this key is pressed, the message "module trigger" will be displayed and a trigger will be sent to the selected module.

4. **Menu** Key

Press the **Module Menu** key to call the top level menu of the currently selected module. Use this key to return to the beginning of a module menu after asserting menu features. This way other branches of the menu tree can be accessed.

5. **Cal/Test** Key

The **Module Cal/Test** menu allows automatic calibration or self test of the currently selection function module.

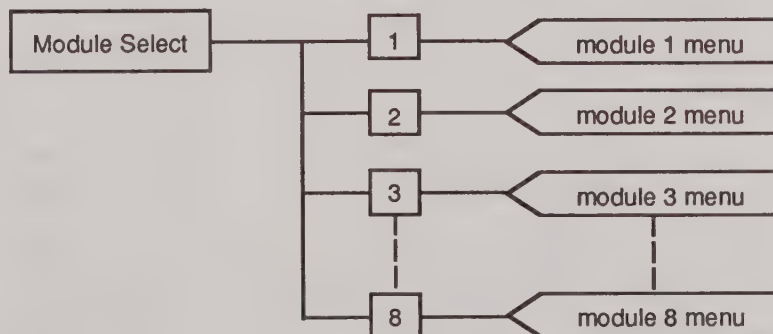


Figure 3-1. **Select** Key Menu Tree

The **Cal/Test** menu allows:

1. Automatic calibration of the currently selected function module to manufacturers specification.
2. Automatic test of the currently selected function module.
3. A status report of the last calibration or self test to see if the calibration was successful or if the module parameters passed the last self test.

The **auto calibration** process tests the output offset and amplitude for accuracy and develops correction factors to offset any errors. These correction factors are in the form of digital values and are stored by the 680 in an auto cal data base; the Ref Cal board uses these digital values to adjust the accuracy of parameters. Part of the data base is a set of nominal values for each parameter which can be substituted for correction factors developed during an auto cal process. Further information about the effect of these values and how they can be used to troubleshoot can be found in the module maintenance manual.

The results of an auto cal process are displayed on the front panel. Any parameter that fails the auto calibration is indicated. Until the problem with a failed parameter is resolved, nominal correction factors for that parameter are substituted; that parameter may be out of tolerance.

In the Arbitrary Waveform Generator, the output offset and amplitude are automatically calibrated.

An auto calibration of the Arbitrary Waveform Generator module is recommended at least once each year and

required whenever the function module is changed to another slot in the 680 System Mainframe chassis.

Selection of the Cal/Test menu defines the Function keys **F1** through **F2** to allow selection and control of the self calibration and test of the currently selected module.

Figure 3-2 shows the Cal/Test menu tree. Use this tree in conjunction with table 3-1 which describes the operation of the function keys **F1** through **F6** when identified by the Cal/Test menu.

6. **Module Reset Key**

The **Module Reset** key defines the Function keys **F1** and **F2** as "module" and "memory" respectively.

Pressing the **module** key **F1** resets all module parameters to the powerup conditions below:

1. Output Frequency: 1 KHz.
2. Waveform Type: Sine.
3. Amplitude: 1 Vpk.
4. Mode: Continuous.
5. Output Relay: Off.

Pressing the memory key **F2** clears all locations of the Arbitrary Waveform memory and requires reprogramming of all arbitrary waveforms.

3.2.2 Detailed Operating Instructions

Pressing the number on the numeric keyboard that corresponds to an Arbitrary Waveform Generator module (as shown on the instrument front panel display) presents the user with a set of labels for function keys **F1**

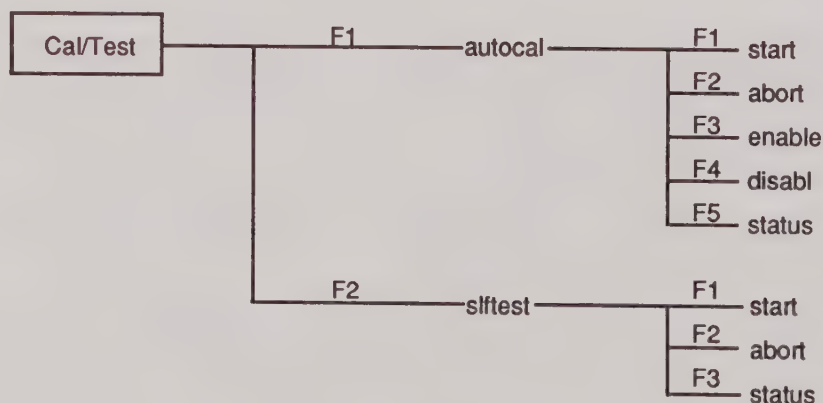


Figure 3-2. Module Cal/Test Menu Tree

through F6. These labels are shown in column one (top level) of table A-7 which describes each key and operation.

3.2.3 The Arb Menu Tree

Figure 3-3 illustrates the menu tree for the Arbitrary Waveform Generator which summarizes the levels and choices available for set-ups.

3.2.4 Connector functions and Specification

In relation to the BNC connectors at the rear of the arb module, table 3-3 lists the function and table 3-4 the electrical specifications of each.

Table 3-1. Module Cal/Test Controls

Top Level	Second Level	Third Level	Description
F1 autocal			This key calls the module Cal/Test menu to the display. Use the Function keys as described below to initiate the desired action.
	F1 start		Starts the module auto cal process. During auto calibration, the second line of the display will indicate the parameter under test. The display will show the result of the calibration with the status message "autocal status: x". Any number other than zero in the place of x indicates failure of at least one parameter to pass calibration.
	F2 abort		Aborts the auto cal process at the completion of the current auto cal step. The auto cal data base will contain data from the previous auto cal data base.
	F3 enable		Activates the auto cal data base if it has been previously disabled.
	F4 disabl		Deactivates the auto cal data base and substitutes nominal values from memory as if the 680 had been powered up for the very first time and no auto cal had ever been performed. This is useful for cases in troubleshooting where the auto cal process has brought a faulty circuit almost within limits. By disabling the auto cal data base, it can be seen if a particular circuit is out of range of the auto cal function.
F2 slftst	F5 status		Displays the status of the last completed auto cal along with the date and time of completion. (Section 3.3.6)
			This key allows self test of the selected function module. Use the keys as described in the second levels that follow.
	F1 start		Initiates the selftest of the selected Arbitrary Waveform Generator function module. When the complete test is finished, the front panel display will show the test status.
	F2 abort		Aborts the self test process and returns the 680 to the top of this menu.
	F3 stat		Displays the status of the last completed self test. (Section 3.3.5)

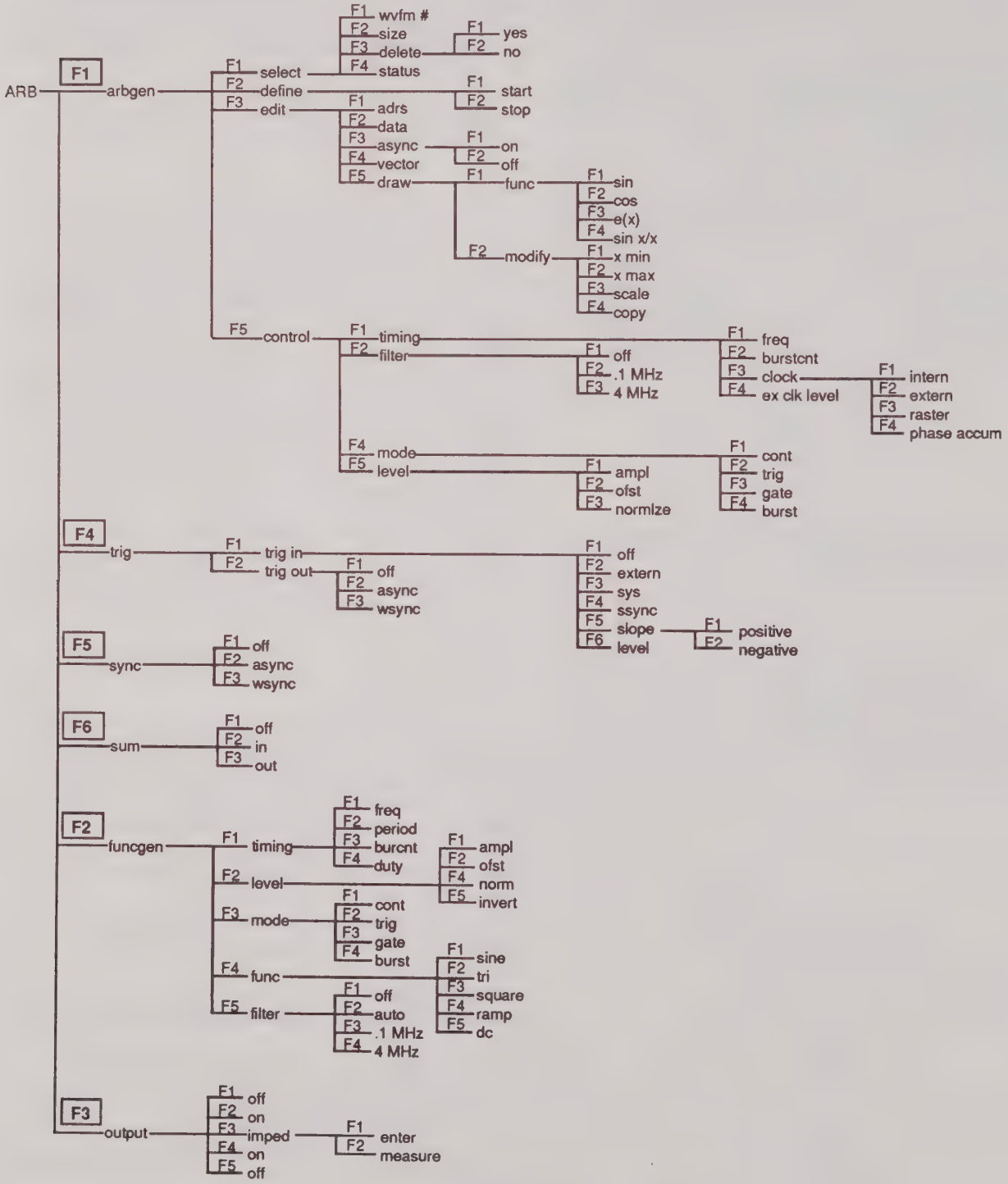


Figure 3-3. Arbitrary Waveform Generator Tree

Table 3-2. ARB Waveform Generator Menu Selections

Top Level	Second Level	Third Level	Description
F1 arbggen			Press this key to call the menus that follow. These menus allow you to select, define, edit, and control arbitrarily defined waveforms.
	select F1		Use this key as the first step in programming new arbitrary waveforms or for selecting a previously programmed arbitrary waveform. To program a new waveform: 1.Assign a number to the new waveform with the wvfm key F1 as described in this table. 2.Allocate the number of ARB memory locations for the waveform with the size key F2 as described in this table. 3.Press the Module Menu key and then the arbggen key F1 . 4.Press the edit key F3 after Arbggen and use the edit controls as described in this table.
		wvfm F1	Arbitrary waveforms are identified by numbers from 0 to 9. Waveforms are assigned or are recalled by using this key and then by entering the value from 0 to 9 with the numeric key pad.
		size F2	This key allows specification of the number of ARB memory locations when programming ARB memory with values for arbitrary waveforms. Every arbitrary waveform must occupy at least 8 locations and can have a maximum of 12K locations. Use the numeric keypad to enter the desired values for waveform size.
		delete F3	The contents of ARB memory allocated for the currently selected waveform can be set to 0 by using this key. After pressing the delete key F3 , the front panel display will ask "ARE YOU SURE?". Press yes (F1) if you are; press no (F2) if you are not.
		status F4	After pressing this key, the display will show: 1.The number of ARB memory locations still available for assignment to arbitrary waveforms. 2.The numbers 0 through 9 already selected to identify arbitrary waveforms.
	define F2		Contiguous portions of an arbitrary waveform can be selected for generation with this key. Specify the start and stop points of the waveform period with the start and stop keys defined next.

Table 3-2. ARB Waveform Generator Menu Selections (Continued)

Top Level	Second Level	Third Level	Description
	edit F3	start F1	The start value defines the waveform address for the beginning of each waveform period.
		stop F2	The stop value defines the waveform address for the end of each waveform period.
			When using the edit features the user can modify any location in ARB memory which in turn affects a change in the generated waveshape.
		adrs F1	After pressing this key, the display will show a location in ARB memory for the waveform number last selected and its associated data value. Any other address-data pair can be displayed by entering its location via the keypad. Changing data in ARB memory requires entry of the location address via the keypad or Cursor controls.
		data F2	To change the data in the displayed address, press the data key F2 and then enter a value from -2047 to 2047 with the numeric keypad or the knob/cursor controls. After entering a new value for the data, and pressing the data key again, the display will show the next higher address and its associated data; a new value for that data can be entered directly. This auto-incrementing feature works only when the data key is pressed between successive values. If the data is censored, it will stay at the current address.
		async F3	This key allows selection of those waveform points where generation of a pulse at the Arb Sync output BNC at the rear of the module is desired. When this key is pressed, the display will show the current selected ARB memory address and the definition for keys F1 and F2 . Pressing F1 will turn the Arb Sync output on at this waveform point; F2 turns it off.
		vector F4	Pressing this key causes the 680 to automatically program all ARB memory locations between the last two entered address values for a linear ramp. The initial value of the ramp is the value of the data associated with the first address selected; the final value of the ramp is the value of the data associated with the second address selected. Data values written over by the vector feature are lost; subsequent selection of the waveform will not cause restoration of any original data values present in the written over locations prior to the selection of the vector feature.
		draw F5	After pressing this key, the display will further define the function keys F1 as func and F2 as modify.

Table 3-2. ARB Waveform Generator Menu Selections (Continued)

Top Level	Second Level	Third Level	Fourth Level	Fifth Level	Description
			F1 Func		After pressing the func key F1 , the desired function is selected with the F1 through F4 function keys. Selection of a function causes all of locations between the start and stop for the currently selected waveform to be programmed with the data values for the selected function.
				F1 sin	F1 Provides sine wave.
				F2 cos	F2 Provides cosine wave.
				F3 e(x)	F3 Provides exp (x) function.
				F4 sinx/x	F4 provides (sin (x))/x function.
			F1 Modify		The data values for the functions sin (x), cos (x), exp (x), and (sin (x))/x can be selected for transfer to currently selected waveform memory locations by making this selection. Also, a contiguous portion of a selected function can be modified and scaled and assigned a new waveform number.
				F1 min	After pressing the modify key F2 , the minimum and maximum ARB memory locations of the current waveform desired for copying to a new waveform can be selected as well as a scale factor from -1.000 to 1.000 for those data values.
				F2 max	F1 selects the beginning address value, F2 selects the ending address value, F3 allows entry of the scale factor via the keypad or Cursor controls, and F4 causes the modified waveform to be copied to the number prompted by the display. Waveforms can only be copied to numbers previously unused.
				F3 scale	
				F4 copy	
	F5 control				Use this menu to control the arb waveform timing, filtering, configuration, output mode and levels. Each press of a key will cause the display to redefine the function keys F1 through F6 .
		F1 timing			From the timing menu the user can select the arbitrary waveform frequency, the burstcount, the clock used for waveform generation and the voltage level at which the external clock becomes valid (this module only recognizes the positive slope of the external clock input as a valid clock). The values for the arbitrary waveform frequency and burstcount can be entered by using the numeric keypad or the Cursor controls. Once the Clock key (F3) is pressed you can select the external Clock In input at the rear of the module as the reference clock used for waveform generation or a programmable internal clock generated by the module. Raster — The arb clock runs at a selected raster frequency. The period of each address step in any waveform is equal to; 1/ raster freq. (Raster 10E3 with 75 point waveform results in a 133.33 Hz waveform). Phase Accumulate — The arb clock runs at 20 MHz when the waveform is in phase accumulate freq. mode.
			F1 Freq		
			F2 Burst Count		
			F4 Ext Clk		
			F3 Clock	F1 intern	
				F2 extern	
				F3 Raster	
				F4 phase accum	
					Ext Clock (Phase Acc Mode) Freq = $\frac{\text{Clk Freq}}{20\text{E6}} \times \text{Prog Freq}$

Table 3-2. ARB Waveform Generator Menu Selections (Continued)

Top Level	Second Level	Third Level	Fourth Level	Description
F4 trig	F1 trig in	F2 filter	F1 off F2 .1 MHz F3 4 MHz	Press this key to select the desired filtering of the output waveform. Three selections are available; off, low pass 4-pole filtering at 0.1 MHz or at low pass 6-pole filtering 4.0 MHz.
		F3 mode	F1 Cont F2 Trig F3 Gate F4 Burst	There are four mode selections: 1.Continuous. Allows continuous generation of the selected arbitrary waveform. 2.Triggered. Only one complete period of the selected arbitrary waveform is generated for each valid selected trigger. 3.Gated. The selected arbitrary waveform is generated only while the selected trigger level is valid. Termination of the input trigger prior to waveform period end will not terminate waveform generation immediately; the entire period will be generated. 4.Burst. A valid selected trigger input will initiate waveform generation for a user programmed number of waveform periods. Waveform generation then ceases until the next valid selected trigger.
		F4 level	F1 ampl F2 offset F3 normalize	Allows control of the amplitude of user defined arbitrary waveforms. When pressed, the display defines the F1 through F3 keys as ampl, ofst, normalize. Press the ampl key F1 to enter the peak to peak voltage of the output waveform. (This is referenced to max data values of ± 2047). Press F2 to enter a DC offset voltage at the output. Scales the waveform to utilize minimum and maximum amplitude values possible in memory. It is not recoverable.
		F1 off		Unless the module has been programmed for continuous operation, triggers are required to initiate waveform generation. Press the trig in key (F1) to select the desired input trigger source and parameter. To accommodate triggering of other devices, this module will generate user selected pulses to the System Trigger (STRIG) bus. Press the trig out key (F2) to use these controls.
		F2 extern		Use this menu to control the module input trigger.
				Disables the module input trigger.
				Selects the signal appearing at the Trig In input BNC on the rear of the module as the module trigger.

Table 3-2. ARB Waveform Generator Menu Selections (Continued)

Top Level	Second Level	Third Level	Fourth Level	Description
F5 sync	F2 trig out	F3 sys	F1 positive F2 negative	Selects the signal appearing on the System Trigger (STRIG) bus as the module trigger.
		F4 ssync		Selects the signal appearing on the 680 System Sync (SSYNC) bus as the module trigger.
		F5 slope		Selects the slope of the trigger as a valid trigger event.
		F6 level		Selects the voltage threshold at which the external Trig In input signal is recognized.
				Selects the signal generated by this module to the System Trigger (STRIG) bus.
		F1 off		Disables the trigger out feature.
		F2 async		Generates an output trigger to the System Trigger (STRIG) bus at any point(s) during the output waveform. The points at which these triggers are to appear are programmed by the user when using the edit menu. (Async on/off – this is valid in user defined model only)
		F3 wsync		Generates an output trigger to the System Trigger (STRIG) bus at the beginning of each output waveform period.
				This section controls the module outputs to the 680 System Sync (SSYNC) bus. See the descriptions that follow.
		F1 off		Disables the module output to the System Sync (SSYNC) bus.
		F2 wsync		Generates a trigger to the System Sync (SSYNC) bus at the beginning of each output waveform period. This signal also appears at the Wvfm Sync output BNC connector at the rear of the module.
		F3 async		Generates a trigger to the System Sync (SSYNC) bus at any point(s) during the output waveform. The points at which these triggers are to appear are programmed by the user when using the edit menu. This signal also appears at the Arb Sync output BNC connector at the rear module. (Only user defined mode is valid)
	F6 sum			Use this menu to control the module analog summing features.
		F1 off		Disables the analog summing features of this module.
		F2 in		The analog voltage from the System Analog Sum (ANASUM) bus is summed with the module output and appears at the Arb Out output.

Table 3-2. ARB Waveform Generator Menu Selections (Continued)

Top Level	Second Level	Third Level	Description
F2 Fungen	F3 out		The module output is summed to the System Analog Sum (ANASUM) bus.
			Use this menu to select and control parameters for standard functions for generation.
	F1 timing		Controls the timing of the function generator output. Select the relevant control by pressing its associated function key.
		F1 freq	Sets the output frequency of the selected function. Use the numeric keypad or the Cursor controls to select the desired value.
		F2 period	Sets the output period (and hence the frequency) of the selected function. Use the numeric keypad or the Cursor controls to select the desired value.
		F3 burstcnt	Sets the number of waveform periods generated for each valid trigger when using the function generator in the burst mode. Use the function generator mode menu to select the burst mode.
		F4 duty	Selects the duty cycle of the output waveform when generating a square or ramp.
	F2 level		Controls the output voltage levels of the selected function.
		F1 ampl	Sets the output voltage level (peak-to-peak) of the selected function. Use the numeric keypad or Cursor controls to enter the desired output voltage level.
		F2 ofst	Sets the DC offset voltage level of the selected output function.
		F4 normal	Make this selection to have the output voltage appear as defined by the ampl setting above
		F5 invert	Make this selection to change the polarity of the function generator output voltage waveform.
	F3 mode		The four function generator output modes are described below.
		F1 cont	Causes continuous generation of the selected output function.
		F2 trig	Generation of the selected output function takes place only on the detection of a valid selected trigger.

Table 3-2. ARB Waveform Generator Menu Selections (Continued)

Top Level	Second Level	Third Level	Description
F3 output	F4 func	F3 gate	Generation of the selected output function takes place only while the selected trigger input is high. Only complete wave form periods are generated as long as a valid gate signal is present at the selected input.
		F4 burst	Allows a user definable number of selected function periods to be generated upon the detection of a valid selected trigger.
			Use this menu to select one of the standard functions described below for generation.
		F1 sine	Selects a sine wave for generation.
		F2 tri	Selects a triangle wave for generation.
		F3 square	Selects a square wave for generation.
		F4 ramp	Selects a ramp (sawtooth) waveform for generation.
		F5 dc	Selects for output a DC voltage equal to the value set for offset in the funcgen level menu.
	filter F5		Press this key to select desired filtering of the output wave form.
		F1 off	Allows no filtering of the output to take place.
		F2 auto	Automatic filter selection. (For sine only)
		F3 0.1 MHz	Selects low pass 4-pole filtering at 0.1 MHz of the output signal.
		F4 4.0 MHz	Selects low pass 6-pole filtering at 4.0 MHz of the output signal.
			Controls the Arb Out output, output impedance and pulse amplitude modulation.
		F1 off	Disables the Arb Out output by deenergizing the Arb Out output relay.
		F2 on	Enables the Arb Out output by energizing the Arb Out output relay.
	F3 impeded		Displays a new set of labels for function keys F1 through F2 that allow the user to set the output impedance.
		F1 enter	Allow the user to enter an impedance value from the numeric keyboard or the knob Cursor controls. (The range is 25 to 1K)

Table 3-2. ARB Waveform Generator Menu Selections (Continued)

Top Level	Second Level	Third Level	Description
	F4 on F5 off	F2 measure	Allows the instrument to adjust the Arb Out output voltage level to the correct level when the value of load impedance is not known. Pulse/Timing Generator modules adjacent to the Arbitrary Waveform Generator module can have their outputs amplitude modulated by the Arbitrary Waveform Generator signal. The keys below turn on or off the out-put signal to the adjacent module.(The arb is always in the lower adjacent slot). Press the on key F4 if the output signal is required by the adjacent timing generator. Press the off key F5 if the output signal is not required by the adjacent timing generator.

Table 3-3. Arbitrary Waveform Generator Connector Functions

Label	Function
Arb Out	This BNC is the Arbitrary Waveform module signal output.
Wvfm Sync	This output generates a synchronization pulse at the beginning of each waveform period.
Arb Sync	This output can be programmed to generate synchronization pulses at any point(s) within a user defined output waveform.
Clock In	An external clock can be selected instead of the clock generated by the Arbitrary Waveform generator module, allowing exact synchronization of generated user defined waveforms with external sources.
Trig In	This is the trigger input for the trigger, gate and burst modes.

Table 3-4. ARB Board Electrical Connector Specifications

Label	Type	Voltage Limits	Impedance	Protection	Other Specifications
Arb Out	Output	10 mVp-p to 20 Vp-p into 50Ω	User Programmable	Short Circuit	Rise/fall: < 25 ns Load Imp: <25 — 10kΩ Programmable: On/Off
Wvfm Sync	Output	< 0.2V and 1.0V>	50Ω	Short Circuit	Rise/fall: < 10 ns Programmable: On/Off
Arb Sync	Output	<0.2V	50Ω	Short Circuit	Rise/fall: < 10 ns Programmable: On/Off
Clock In	Input	+10V to -10V	>1 kΩ	±15V	Timing: 25 ns min pulse width.
Trig In	Input	+10V to -10V	>1 kΩ	±15V	Timing: 25 ns min pulse width.

3.3 OPERATING THE 680 FROM THE GPIB

The IEEE-488 General Purpose Interface Bus interface for the Model 680 uses a single connector and interface for all of the instrument modules in the chassis. A single primary address is used for the entire 680 system. The individual modules use a secondary address (as per IEEE-488.1 standard) for commands to each individual module. The secondary addresses are 0 through 9. The Model 680 system chassis commands are in module 0. The plug in modules are in modules 1 through 8, with modules being numbered by their physical order in the chassis, module 1 being closest to the Ref/Cal board and module 8 being closest to the power supply. Module 9 is a virtual module containing the global commands that broadcast to all modules.

The chassis' primary address can be set by either the DIP switch on the rear panel or by programming the address on the 680 front panel. The DIP switch has eight switches, five of which are used for setting the GPIB primary address. The next one is MATE enable and the last one is the front panel enable. The primary address can also be programmed from the front panel if this switch is enabled. See Section 2.6.3.

3.3.1 GPIB Compliance Requirements

The 680 GPIB interface meets the following compliance criteria to the IEEE-488.1 standard:

Source Handshake: SH1
Acceptor Handshake: AH1
Talker: TE6

Listener: LE4
Service Request: SR1
Remote/Local: RL1
Parallel Poll: PPO
Device Clear: DC1
Device Trigger: DT1
Electrical: E1

The 680's GPIB software interface uses a subset of the IEEE-488.2 Draft Standard, "Codes, Formats, Protocols and Common Commands For Use With ANSI/IEEE Std 488.1 — 198x, IEEE Standard Digital Interface for Programmable Instrumentation" version, dated 27 March 1987. Note that this is still an unapproved draft standard before the IEEE and certain details may change in the future.

Talk messages are terminated with the LF EOI. Listen messages are terminated as per IEEE-488.2. Carriage Returns are treated as white space.

3.3.2 GPIB Command Syntax

The 680 uses a Compound Header Organization as described in Appendix A of the IEEE-488.2 proposed standard. This allows multiple commands to a device on a single command line. It also allows the instrument to organize its commands into a tree structured hierarchy.

If a module uses a tree structured command hierarchy, then the command string must specify the complete

path used to traverse the tree from the root node of the module. Each module has its own tree with its own root node. The traversal path must specify the "intermediate node" names at each branch. The actual command must always be at an end node, also known as a "leaf node" of the tree. The node names are delimited by colons ":". A typical command from a controller running "T Basic" would look like:

```
PRINT 15,04; "INTRMED-NODE1: INTRMED-
NODE2:COMMAND PARAM"
```

Here, the primary address of the 680 system is 15; the secondary address is 4, indicating it is a command to the 4th module from the Ref/Cal board in the chassis; the tree traversal path is through intermediate node 1, intermediate node 2 and then to the command "COMMAND" at the leaf node; the command has a parameter "PARAM" which ends the string. Note that the parameter is separated from the command by a space character " ".

Multiple commands are permitted on one command line by following the first command with a semi-colon ";" and the next command. If the next command is located at the same intermediate node as the first, the entire string is not necessary. Just the leaf node command name is required.

```
PRINT 15,04; "IM1:IM2:CMD1 PARAM1;CMD2
PARAM2;CMD3"
```

In the example the tree traversal is from the root through intermediate node IM1 to intermediate node IM2 to the command CMD1, all delimited by colons. The parameter PARAM1 is delimited by a space and the entire command is terminated with a semi-colon. Following the semi-colon is another command CMD2. This command must be at the same node in the instrument's GPIB command tree as CMD1. It also has a parameter PARAM2 separated by a space. The second command is also terminated by a semi-colon which is followed by a third command CMD3. The third command has no parameter and so it ends the entire string. The tree structure for the previous command is shown in figure 3-4.

Spaces are ignored and can be interspersed within the command string to enhance the readability. The previous example can be made more readable by adding spaces after the semi-colons as follows:

```
PRINT 15,04; "IM1:IM2:CMD1 PARAM1; CMD2
PARAM2; CMD3"
```

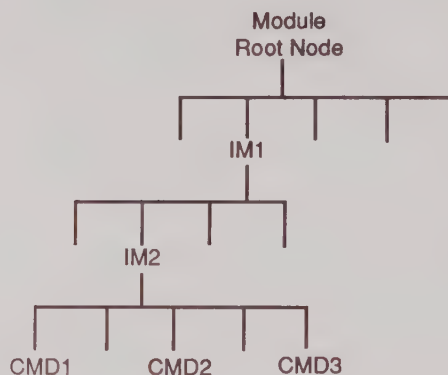


Figure 3-4. Module Nodes

Similarly, spaces could also be added after the colons:

```
PRINT 15,04; "IM1: IM2: CMD1 PARAM1; CMD2
PARAM2; CMD3"
```

To invoke two commands from different intermediate nodes in one string, merely follow the semi-colon of the first command with a leading colon. This leading colon indicates to the parser that the tree traversal for the next command will start at the top, or root node of the tree again. See the tree structure in figure 3-5.

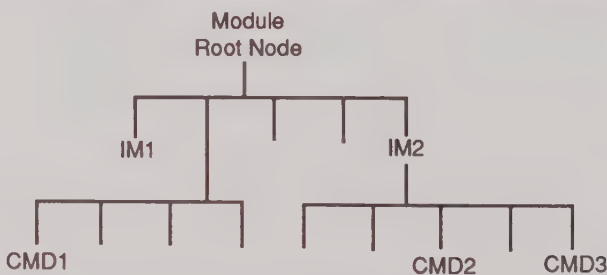


Figure 3-5. Module Nodes

The command to execute CMD1, CMD2 and CMD3 is:

```
PRINT 15,04; "IM1:CMD1 PARAM1;:IM2:CMD2
PARAM2:CMD3"
```

Again, spaces are permitted between the semi-colon and the colon to enhance the readability; i.e. ";;" becomes " ; ;".

3.3.2.1 Enhanced Tree Traversal

The 680 uses the "Enhanced Tree Walking Implementation" as described in Section A.1.2 of the IEEE-488.2 document and is illustrated in figure 3-6.

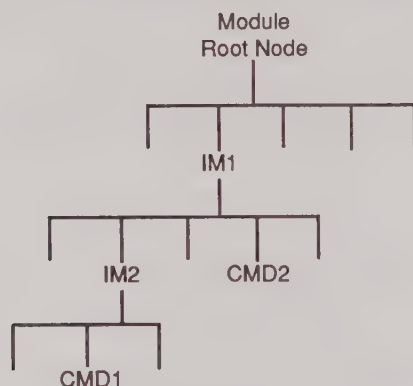


Figure 3-6. Enhanced Tree Traversal

The command sequence to execute both CMD1 and then CMD2 would be:

```
PRINT 15,04; "IM1:IM2:CMD1 PARAM1;;IM1:CMD2
PARAM2"
```

However, with the enhanced tree traversal the tree does not need to be re-traversed from the root in order to reach the second command CMD2. The following string is adequate:

```
PRINT 15,04; "IM1:IM2:CMD1 PARAM1;CMD2
PARAM2"
```

After the first command CMD1 is executed, the command list at intermediate node IM2 is searched for the command CMD2. If the parser does not find CMD2 at that node, it will trace back to its parent node and search for CMD2 there. It will continue this process recursively until it reaches the root node for the module. If it is not found in the root node a command error is flagged and the parser goes on to the next command.

In this case, the parser will not find CMD2 at intermediate node IM2, so it will trace back to IM2's parent node, intermediate node IM1. It will search IM1 for CMD2 and find it there and then perform the function appropriate for that command.

As an example, the Model 680-01 Arbitrary Waveform Generator has three intermediate nodes: the module root node, a function generator node and an arbitrary waveform generator node. The function generator node uses

the arbitrary waveform generator hardware to emulate a normal function generator with the usual function generator waveforms such as sine, triangle, square and ramp. The arbitrary waveform generator node has all of the commands for programming arbitrary waveforms into the waveform memory. The root node contains all of the common commands such as output amplifier control.

A root node command, such as setting the output impedance to 50Ω and then turning the output on (closing the output relay) would be:

```
"IMPEDANCE 50; OUTPUT ON; EXECUTE"
```

To control any of the function generator commands the intermediate node "FUNCGEN" must be specified.

```
"FUNCGEN: FREQUENCY 5E4; EXECUTE"
```

To control multiple function generator commands on a single line the intermediate node FUNCGEN need only be specified once:

```
"FUNCGEN: FREQ 5E4; FUNC SINE; EXEC"
```

Note: Abbreviated forms for the command names have been substituted to save.

To set up commands in the FUNCGEN intermediate node and then commands in the root node on the same line; the semi-colon, colon sequence ";;" may be used to indicate a return to the root node:

```
"FUNCGEN: FREQ 5E4; FUNC SINE; :IMPEDANCE
50; OUTPUT ON; EXEC"
```

This sequence is not required (although acceptable) since the 680 GPIB parser implements the Enhanced Tree Walking function as described in the IEEE-488.2 document. Instead, the colon in front of the command IMPEDANCE may be dropped as follows:

```
"FUNCGEN: FREQ 5E4; FUNC SINE; IMPEDANCE
50; OUTPUT ON; EXEC"
```

Here, the command FREQ is found at intermediate node FUNCGEN and set to the value 5E4. Then the command FUNC is found at the same node and set to the parameter SINE. Next, the parser looks for the command IMPEDANCE in the FUNCGEN intermediate node. The parser does not find it there, so it goes back up to the next node back up the tree (its parent) which in this example happens to be the root node of the module. The parser looks for the command IMPEDANCE at this node. It finds

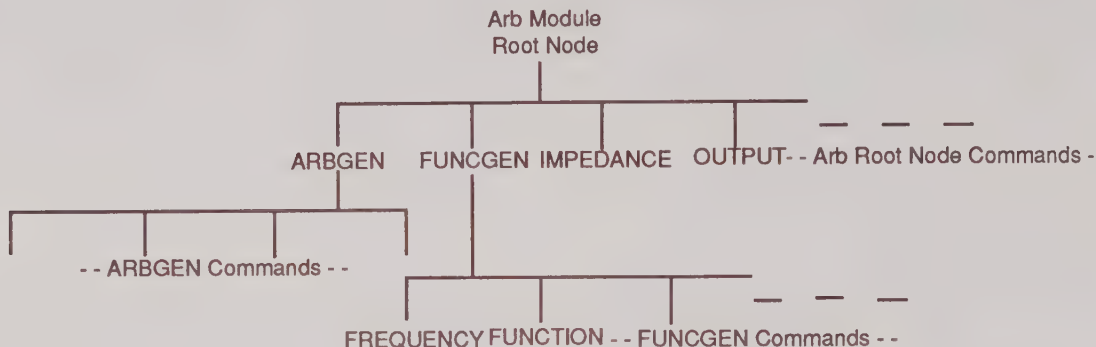


Figure 3-7. Example Command Tree for Arb

it here and set it to 50. Then it searches for the command OUTPUT in the root node. The parser remains at the node where it found the last command for the next command search. It does not return to the originally specified node. It finds OUTPUT in the root node and sets it to ON. Last, it searches for the command EXEC in the root node and executes all of the previous settings. Figure 3-7 shows a diagram of the commands used above.

The controller may query the device for status information or for the results of measurements. A query occurs whenever the instrument receives a command immediately followed by question mark "?". The question mark indicates to the instrument that this is a query instead of a command. The instrument then assembles a response string, usually ASCII text, and puts it into a response buffer. When the instrument's GPIB interface hardware is placed into "talker mode" the response string is transferred onto the IEEE-488 bus.

3.3.2.2. Arb Generator Tree structure programming

Desired parameters:

- Amplitude 5vp-p
- Output on
- Frequency 10Khz
- Mode triggered
- Triggerinput external
- Function triangle

The normal reaction to build a string to execute these parameters would be as follows:

```
" :FUNCGEN:AMPLITUDE 5;OUTPUT ON;
FREQUENCY 10E3;MODE TRIGGERED;
TRIGGERINPUT EXTERNAL;FUNCTION
TRIANGLE;EXECUTE"
```

The above string would generate a command error on FREQUENCY because of the tree structure. A partial tree of the arb generator with only the needed commands is listed in figure 3-8.

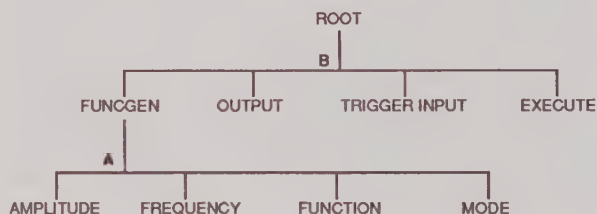


Figure 3-8. Arb Generator Tree Structure

Tree traversal down has to be done with node labels. A leading colon or a semicolon-colon pair will cause parser to jump up to the ROOT node before parsing the next command string portion. If the parser cannot find a command in the current node, it will traverse back up the tree to the preceeding node to look for the command. If the ROOT node is reached and the command is not found, then the command error is generated.

To analyze why the command error occurred, we will begin at the start of string and go through it one part at a time. First, the parser encounters the colon which will make parser jump to the ROOT node at point A to start parsing. Next comes FUNCGEN which will traverse to point B due to trailing colon. AMPLITUDE is next, so the parser will send amplitude and value to the module setting routine. AMPLITUDE is found at node marked by B, so parser will still be here when it gets OUTPUT. In searching for OUTPUT, the parser will not find it at

present node so will traverse back up to point A. In searching here, the parser will find OUTPUT and send it with value to it's setting routine. The parser is now at point A so when it next gets FREQUENCY, it will not find it at this node. Point A is the ROOT node, therefore a command error is generated.

Below there are several examples of valid combinations to execute all the above commands. Both, full and minimum uniqueness, have been used in examples.

```
":OUTPUT ON;TRIGGERINPUT
EXTERNAL;;FUNCGEN:
AMPLITUDE 5;FREQUENCY 10E3;
FUNCTION TRIANGLE;
MODE TRIGGERED;EXECUTE"
```

```
"OT ON;TRIGI E;;FUNCGEN:AMP 5;FR
10E3;FNC TR;MODE TR;EXEC"
```

```
":FUNCGEN:AMPLITUDE 5;FREQUENCY 10E3;
FUNCTION TRIANGLE;MODE TRIGGERED;
:OUTPUT ON;TRIGGERINPUT EXTERNAL;
EXECUTE"
```

```
"":FUNCGEN:AMP 5;FR 10E3;FNC TR;MODE TR;
:OT ON;TRIGI E;EXEC"
```

When using download command, be aware that data starts at address 0 irregardless what start and stop points are set to. If you try to download less than 8 points or greater than current waveform size, an error message will result.

The copy command will copy block set up by xmax and xmin from current waveform space to a space created by copy. Copy will assign the waveform number designated to this new space. It also scales this new waveform according to current scale value.

Draw functions will set stop point according to following table if waveform size exceeds that value plus one.

Sine	8192
Cosine	8192
e(x)	4095
Sine(x)/(x)	8191

These waveforms may be drawn into partial waveform space by setting start and stop before drawing them.

3.3.3 GPIB Command Definitions

The 680 uses three kinds of GPIB commands:

1. 680 chassis specific commands.
2. Common commands.
3. Instrument module specific commands.

Table 3-5 lists the ARB module specific commands and all common commands.

Some commands pertain to all function modules and are called the common commands. All modules respond to the common commands in the same way.

Table 3-5. ARB Module Specific and Common Commands

Notes:

Commands-> Uppercase characters are mandatory
Lowercase characters are optional and
Underscore is optional (for readability)

For the value of a parameter, the string or numeric equivalent may be sent.

Numbers used in command strings and on queries are either floating point(f) or integer(n) as noted.

<ascii string> means an ascii string message will be returned in these cases.

Ranges are for parameter, there may be times when these limits are not valid due to other parameter setups. For example: FUNCTION SQUARE;FREQUENCY 10E6 is o.k. but in the case of FUNCTION SINE;FREQUENCY 10E6 would not be o.k. Max frequency of sine is 4e6. See specifications for possible conflicts.

Command	Range/String	Function
ARBGEN:		Select arbitrary waveform generator mode
FUNCGEN:		Selects function generator mode

Table 3-5. ARB Module Specific and Common Commands (Continued)

Command	Range/String	Function
FUNCTION GENERATOR COMMANDS		
FUNCGEN:	-----	Sets ARB module to Function Gen mode
MODE		
MODE	0 to 3 (default = 0)	Selects main operating mode
CoNtinuous	0	Continuous waveform mode
TRiggered	1	Triggered (one cycle) mode
SyncGate	2	Synchronous gating mode
BuRst	3	Burst mode
MODE?	MODE n	Returns main mode
FUNCTION		
FuNction	0 to 4 (default = 0)	Selects module output waveform
SiNe	0	Selects sine output
TRiangle	1	Selects triangle output
SQuare	2	Selects squarewave output
RaMp	3	Selects ramp output
DC	4	Selects DC output
FuNction?	FUNCTION n	Returns module output waveform
LEVEL		
AMPlitude	10 E-3 to 20 (default = 2.0)	Sets module output amplitude
AMPlitude?	AMPLITUDE f	Returns module output amplitude
OFFset	-10 to +10 (default = 0.0)	Sets waveform offset voltage
OFFset?	OFFSET f	Returns waveform offset voltage
POLarity	0 to 1 (default = 0)	Selects funcgen waveform polarity
Normal	0	Normal funcgen waveform
Invert	1	Inverts the funcgen waveform
POLarity?	POLARITY n	Returns waveform funcgen polarity
TIMING		
FRequency	10E-6 to 10E6 (default = 1E3)	Sets generator output frequency
FRequency?	FREQUENCY f	Returns generator output frequency
PeRiod	1E-7 to 1e7 (default = 1E-3)	Sets period of main output
PeRiod?	PERIOD f	Returns period of main output
DuTycycle	0.1 to 99.9 (default = 50.0)	Sets duty cycle of square/ramp waves
DuTycycle?	DUTYCYCLE f	Returns duty cycle
BurstCount	1 to 65535 (default = 2)	Sets number of cycles in burst
BurstCount?	BURSTCOUNT n	Returns number of cycles in burst

Table 3-5. ARB Module Specific and Common Commands (Continued)

Command	Range/String	Function
FILTER		
FiLTer	0 to 3 (default = 0)	Select ARB filter
OFF	0	Disables ARB filter
KhZ100	1	Enables 100khz, 4 pole ARB filter
Mhz4	2	Enables 4 MHz, 6 pole ARB filter
Auto	3	Automatic filter selection for sine mode
FiLTer?	FILTER n	Returns filter mode
ARBGEN COMMANDS		
ARBGEN	-----	Sets ARB module to ARBGEN mode
MODE		
MODE	0, 5 to 7 (default = 0)	Selects main ARB operating mode
CoNtinuous	0	Continuous waveform mode
TRiggered	7	Triggered (one cycle) mode
SyncGate	5	Synchronous gating mode
BuRst	6	Burst mode
MODE?	MODE n	Returns main ARB mode
LEVEL		
AMPlitude_Auto	-----	Enables ARB auto amplitude scaling
AMPlitude	20E-3 to 20 (default = 2.0)	Sets ARB amplitude
AMPlitude?	AMPLITUDE f	Returns ARB amplitude
Offset	-10 to +10 (default = 0.0)	DC offset for ARBGEN mode
Offset?	OFFSET f	Returns offset of ARB output
TIMING		
CLock_Source	0 to 1 (default = 0)	Select ARB clock source
INTernal	0	Selects internal clock for ARB
EXTernal	1	Selects external clock for ARB
CLock_Source?	CLOCKSOURCE n	Returns ARB clock source
RASTer_scan	10E-6 TO 20E6 (default = 1E4)	Selects raster scan mode/freq for ARB
RASTer_scan?	RASTERSCAN f	Returns raster frequency
PHase_accumulate	-----	Selects ARB phase accum mode
PHase_accumulate?	PHASEACCUMULATE n	Returns ARB clock mode 0 = Phase acc. 1 = Raster
CLock_leVeL	-10 to +10 (default = 1.6)	Sets external ARB clock level ARB CLock
CLock_leVeL?	CLOCKLEVEL f	Returns external ARB clock level
FRrequency	10e-6 to 2e6 (default = 1e3)	ARB waveform output frequency (phase accumulate mode only)
FRrequency?	FREQUENCY: f	Returns ARB waveform output frequency
BurstCount	1 to 65535 (default = 2)	Sets burst count in ARB mode
BurstCount?	BURSTCOUNT n	Returns burst count in ARB mode

Table 3-5. ARB Module Specific and Common Commands (Continued)

Command	Range/String	Function
FILTER		
FiLTer	0 to 2 (default = 0)	Select ARB filter
OFF	0	Disables ARB filter
KhZ100	1	Enables 100khz, 4 pole ARB filter
MhZ4	2	Enables 4 MHz, 6 pole ARB filter
FiLTer?	FILTER n	Returns filter mode
SELECT		
WaVeForM_Number	0 to 9 (default = none)	Selects waveform(0-9) to be modified
WaVeForM_Number?	WAVEFORMNUMBER n	Returns current waveform number -1 means no waveform selected.
WaVeForM_SiZe	8 to 12288 (default = none)	Sets ARB waveform size
WaVeForM_SiZe?	WAVEFORMSIZE n	Returns ARB waveform size
WaVeForM_Length?	WAVEFORMLENGTH n	Returns length from start to stop pts.
WaVeForM_DeLete	-----	Deletes selected waveform
WaVeForM_StatUs?	WAVEFORMSTATUS n	Returns amount of available waveform memory
DEFINE		
WaVeForM_StaRt	0 to 12287 (default = 1st pt.)	Sets starting waveform address
WaVeForM_StaRt?	WAVEFORMSTART n	Returns starting waveform address
WaVeForM_StoP	0 to 12287 (default = last pt.)	Sets ending waveform address
WaVeForM_StoP?	WAVEFORMSTOP n	Returns ending waveform address
EDIT		
CLearMemory	-----	Initializes waveform memory
DownLoad	n,n,n,...	ARB waveform data download mode (min 8 pts., values between +/- 2047)
EnDdownLoad	-----	Exit data download mode
WaVeForM_ADdress	0 to 12287	Set address of active waveform
WaVeForM_ADdress?	WAVEFORMADDRESS n	Returns currently selected address
WaVeForM_DaTa	-2047 to 2047	Enter data into waveform memory
WaVeForM_DaTa?	WAVEFORMDATA n	Returns data of currently selected address
WaVeForM_ASync	0 or 1 (default = 0)	Set async bit low(0) or high(1) at current address
WaVeForM_ASync?	WAVEFORMASYNC n	Returns async status of selected address
Vector	-----	Enable line generator between points
DRAW		
XmaX	0 to 12287	Max address of waveform in edit block
XmaX?	XMAX n	Returns max address in edit block
XmiN	0 to 12287	Min address of waveform in edit block
XmiN?	XMIN n	Returns Min address in edit block

Table 3-5. ARB Module Specific and Common Commands (Continued)

Command	Range/String	Function
FUNCTION		
FuNction	0 to 3	Function used to create or modify ARB data
SiNe	0	Insert sine wave into edit block
Cosine	1	Insert cosine wave into edit block
Logx	2	Insert log(x) curve into edit block
SinC	3	Insert sin x/x into edit block
MODIFY		
Copy	0 to 9	Copies edit block into waveform #
Scale	-1.0 to 1.0 (default = 1.0)	Sets scale for copy command
Scale?	SCALE n	Returns edit block scale factor
ARB & FUNC GEN COMMON COMMANDS		
OUTPUT		
OuTput	0 to 1 (default = 0)	Sets module output mode
OFF	0	Opens output relay
ON	1	Closes output relay
OuTput?	OUTPUT n	Returns module output on/off mode
Impedance	25 to 1000 (default = 50.0)	Selects source, enters load impedance
Impedance?	IMPEDANCE n	Returns current impedance
MeasUre?	MEASURE f	Returns measured load impedance
AMPlitude_Mod	0 to 1 (default = 0)	AM source selection
OFF	0	Disables AM source
ON	1	Enables AM source
AMPlitude_Mod?	AMPLITUDEMOD n	Returns AM source
TRIGGER		
TRIGger_Input	0 to 3 (default = 0)	Selects trigger input source
OFF	0	Disables trigger input
External	1	Selects external bnc as trigger input
STrig	2	Selects system trigger as trig input
SSync	3	Selects system sync as trig input
TRIGger_Input?	TRIGGERINPUT n	Returns trigger input source
Trigger_LeVeL	-10 to 10 (default = 1.6)	Sets response level to ext trigger
Trigger_LeVeL?	TRIGGERLEVEL f	Returns trigger response level
Trigger_SLoPe	0 to 1 (default = 0)	Selects response slope of ext trig
Positive	0	Respond to positive exttrig slope
Negative	1	Respond to negative exttrig slope
Trigger_SLoPe?	TRIGGERSLOPE n	Returns selected trigger slope

Table 3-5 ARB Module Specific and Common Commands (Continued)

Command	Range/String	Function
TRIGGER (Continued)		
TRIGger_Output	0 to 2 (default = 0)	Selects trigger output source
OFF	0	Disables trigger output
Arb_sync	1	Selects arbsync as trigger output
Waveform_sync	2	Selects waveform sync as trigger out
TRIGger_Output?	TRIGGEROUTPUT n	Returns trigger output source
*TRG	-----	Triggers waveforms
SYNC		
Sync_Output	0 to 2 (default = 0)	Selects sync output source
OFF	0	Disables sync output
Arb_sync	2	Selects arbsync as the sync signal
Waveform_sync	1	Selects waveform sync as the sync signal
Sync_Output?	SYNCOUPTUT n	Returns sync output source
SUM		
SUM	0 to 2 (default = 0)	Selects system summing bus control
OFF	0	Disconnect module from summing bus
INput	1	Receive the system signal into the module
OUTput	2	Send the module output onto the sum bus
SUM?	SUM n	Returns system sum mode
AUTOCAL		
*CAL?	n	Starts auto calibration & returns status
@CAS?	n	Returns status of latest autocal
AutoCAL_Disable	-----	Disables module autocal corrections
AutoCAL_Enable	-----	Enables module autocal corrections
STORED SETTING		
*SAV	1 to 99	Stores module setup
*SAV	-1 to -99	Deletes a stored module setup
*RCL	1 to 99	Recalls specified module stored setting
RESET		
*RST	-----	Resets parameters of Selected module
SELFTEST		
*TST?	n	Starts module selftest & returns status
@STS?	n	Returns status of last selftest

Table 3-5. ARB Module Specific and Common Commands (Continued)

Command	Range/String	Function
MISC		
EXECute	-----	Executes a command string
*IDN?	WAVETEK,680-01,0,Vn.n.n	Returns ARB identification and software version(Vn.n.n)
*OPC	-----	Will set operation complete bit of ESR
*CLS	-----	Clears event status register
*ESE	0 to 255 (default = 0)	Sets event status enable mask
*ESE?	n	Returns event status enable mask
*ESR?	n	Returns event status register value
*SRE	0 to 255 (default = 0)	Sets service request enable mask
*SRE?	n	Returns service request enable mask
*STB?	n	Returns service request status byte
*TRG	-----	Trigger command to module
@CME?	<ascii string>	Query for command error message
@EXE?	<ascii string>	Query for execute error message
@QYE?	<ascii string>	Query for query error message
@DDE?	<ascii string>	Query for device dependent error message

Manufacturers of function modules other than Wavetek do not necessarily conform to the IEEE-488.2 protocols and may have command sets that are not compatible with the common commands described here. Check the manufacturers programming guide for further information.

Table 3-6 describes those 680 common commands that do not conform to the IEEE-488.2 definition. All of these common commands are identified with the "@" prefix in their command string.

Table 3-6. Nonstandard 680 Common Commands

Command String	Command Name
@CME?	Command Error Query
@EXE?	Execution Error Query
@DDE?	Device Dependent Error Query
@QYE?	Query Error Query
@STS?	Report status of last self test, without invoking a new self test
@CAS?	Report status of last auto-cal, without invoking a new auto-cal

3.3.4 GPIB Error Handling and Status Reporting

Errors and status in the 680 are handled as described for Device Status Reporting consistent with the IEEE-488.2 standard in Chapter 11. Errors and status may be monitored by reading the IEEE-488.1 Status Register, either by serial polling the 680 or by sending a Status Byte read command (*STB?) to the 680. Each module has its own Status Byte associated with its own secondary address. The serial poll or the *STB? query have to be done to the module's primary and secondary address.

Three bits in the Status Byte are defined as follows:

- Bit 6 (DI07): RQS/MSS
RQS/MSS acts as a summary bit for the rest of the Status Byte bits. If any of the other Status Byte bits are asserted along with their corresponding mask bits in the Service Request Enable Register, then the RQS/MSS bit will be asserted. This allows the controller to test for the RQS/MSS bit for selected information (selected by the mask bits in the Service Request Enable Register) automatically without having to mask and test the Status Byte manually.
RQS is in response to a serial poll and is partially defined in the IEEE-488.1 spec. and further defined in the IEEE-488.2 spec. RQS will be true during a serial poll if the 680 has an SRQ true condition pending.

MSS is in response to a *STB? query and is defined in the IEEE-488.2 spec. MSS will be true if the logical AND of the Status Byte bits and a mask byte, the Service Request Enable Register yields a true result in any bit location (except bit 6 of course). The only bits used in the 680 are bit 4 (DI05) and bit 5 (DI06) mentioned below.

- Bit 5 (DI06): ESB
Standard Event Status Bit Summary Message. This is a summary message bit for the Standard Event Status Register, q.v. next section.
- Bit 4 (DI05): MAV
Message Available Queue Summary Bit. This bit is always true if another byte is available to be output to the controller. When the queue is empty, the MAV bit is cleared.

The remaining bits in the 680 Status Byte have no effect. The ESB bit is a summary bit for another status register, called the Standard Event Status register, which is used to extend the types of status information available to the controller from the instrument's status functions. The IEEE-488-2 document defines all eight bits for particular functions. The 680 only uses a subset of these. They are as follows:

- Bit 7: Not Used (Power On)
- Bit 6: Not Used (User Request)
- Bit 5: Command Error
Set to true whenever a syntax error is encountered in the command string to the 680.
- Bit 4: Execution Error
Set whenever a parameter exceeds the range available for that parameter, except for inter-parameter conflict errors which are handled by bit 3.
- Bit 3: Device Dependent Error
Set whenever the instrument module encounters an error specifically associated with the operation of that type of module. This includes inter-parameter conflict errors.
- Bit 2: Query Error
Set whenever a query is made to the 680 for which no response is available.
- Bit 1: Not Used (Request Control)
- Bit 0: Operation Complete

Set whenever the last command has finished execution and the 680 is ready to accept another command or the results from the last query are available.

This register, along with a mask enable register called the Standard Event Status Enable Register, is used to set the ESB bit in the Status Byte of the 680 GPIB interface. The Standard Event Status Register (ESR) is bit-wise logically ANDed with the Standard Event Status Enable Register (ESE) to generate the ESB bit. If any of the bits in the ESR are true along with the corresponding bits in the mask ESE, then the Event Status Summary Bit (ESB, bit 6) in the GPIB Status Byte will be asserted. This way the Status Byte can be serial polled to see if any one of the conditions in the ESR has occurred.

Below is a list of the possible error messages that might occur during operation. Each is listed inside quotes with explanation of what it means.

1. "amplitude + offset out of range"
Peak amplitude added to offset value exceeds maximum limit of output amplifier (+/- 10v peak).
2. "no auto-filter for selected function"
Auto filter only allowed in sine for function generator.
3. "*** <parameter>: limit error ***"
This error message will happen any time the value sent exceeds Timing Generator maximum limits. *Parameter* is any of the parameters that takes a value with it. (Amplitude being set for 25v will result in " *** amplitude: limit error ***"
4. "*** illegal function for duty cycle ***"
Duty cycle only allowed in square and ramp functions.
5. "*** frequency for function out of range ***"
Maximum frequency varies depending on which function is selected (see specifications).
6. "no duty at high frequency"
Duty cycle not allowed above 1Mhz frequency.
7. "could not allocate system memory"
"could not free memory"
"could not free system memory"
"error in alloc system memory"
"can not alloc system memory for download"
When download or autocal is done, the processor will allocate dynamic memory for temporary storage of the data. It frees this space after completion. This error should not happen under normal conditions.

8. "recall database error"
"recall checksum error"
When doing autocal or selftest, the Arb Generator will store current settings before starting and then recall them after completion. If the checksum fails during recall, this error will result. The same message applies to normal stored settings. This error should not occur during normal operation.
9. "cal data base corrupted, re-autocal"
Attempt to enable autocal database was made and checksum or status bit information was garbage. Arb needs autocal run to correct problem.
10. "vectoring not posible, bad address"
The last two addresses selected were invalid. The second was before the first or they both have not been selected.
11. "xmin greater than xmax"
Xmin is start address of copy block and xmax is ending address of copy block, therefore smin has to be less than xmax.
12. "xmax - xmin + 1 less than 8 points"
Minimum size of copy block is 8 points(minimum waveform size).
13. "xmax outside waveform space!!"
Xmax is set to an address value that is beyond last address of selected waveform.
14. "too many points sent in download"
The number of points sent in download exceeded the size of selected waveform.
15. "download failed!!"
The waveform number and size have not been selected prior to download.
16. "insufficient memory to allocate"
This message will occur when copy needs more space for block than is available due to already allocated space. Maximum space is 12288 total.
17. "overflow address error"
"overflow address error, try again"
If selected address is outside waveform space of current waveform, one of these errors will occur.
18. "waveform size not set, can't edit"
If address executed when a waveform is not selected, this message will occur.
19. "size already exists for waveform"
Once size has been defined for a waveform, you cannot redefine it. To change the size, you have to delete the waveform and re-select it with the new size desired.
20. "stop in another waveform space"
Stop point is not within currently selected waveform space.
21. "waveform less than 8 points"
Stop - start + 1 is less than minimum waveform size.
22. "no frequency change in raster mode"
While in raster mode, you can only change frequency by changing raster freq value or start and stop points. Actual frequency of output is equal to raster freq divided by length of selected waveform.
23. "waveform does not have size"
This error message is caused by trying to normalize waveform when there is no size to do it on.
24. "no quick cal for module"
Quick cal is not implemented on Arb module.

3.3.5 Arb. Self Test Error Codes

The ARB self tests use the counter and DVM located on the Ref/Cal card. The firmware controls the generation of known signals on the ARB card and these signals are routed to the counter and DVM through DG508 8 to 1 multiplexers located on the ARB main board.

Below is a list of the error codes returned by the ARB self test and their meaning. A brief description of the self test is given under the error codes it generates.

01 Hex (1 Dec)

Amplitude was programmed to 4.0 Vpp and the measured pre-amp output test point voltage was not within 20% of its expected value of 1.78 volts.

02 Hex (2 Dec)

Amplitude was programmed to 4.0 Vpp and the measured filter output test point voltage was not within 20% of its expected value of 1.78 volts.

04 Hex (4 Dec)

Data base error (checksum)

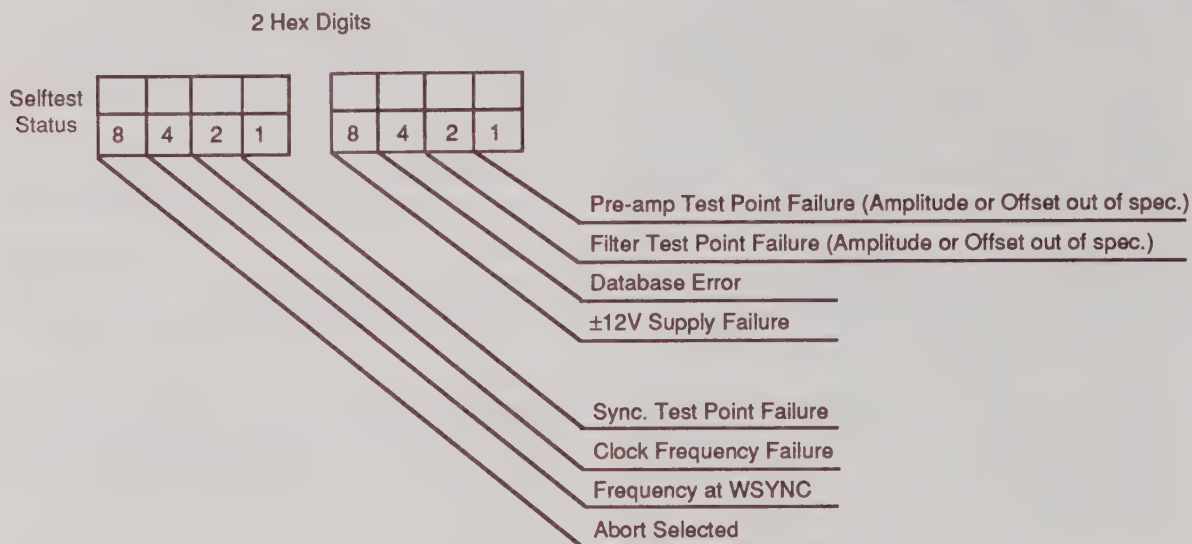


Figure 3-6. Module Self Test Status

08 Hex (8 Dec)

The 12V supply voltage is added to the —12V supply voltage. The expected result should be 0 volts. An error is reported if the measured 12V test point voltage was not within 0.5 volts.

10 Hex (16 Dec)

The SYNC test point voltage was not in the range: 1.0 volts • Vsync • 1.5 volts

20 Hex (32 Dec)

The frequency of WCLK at the WCLK test point was measured below 19 MHz. Its expected value is 20 MHz.

40 Hex (64 Dec)

WSYNC is programmed to the frequencies 125 kHz, 250 kHz, 500 kHz, 1 Mhz and 2 MHz. The frequency of WSYNC is measured at the WSYNC test point for each of these frequencies. If the measured frequency was not within 20 of its expected value an error is set.

80 Hex (128 Dec)

The abort key was pressed while performing the self test.

Status

These self test status hex digits are weighted and represent failures depending on whether a digit is set (failed) or reset (passed), as seen in figure 3-6. For example, a selftest status of 42 (0100 0010) would indicate two failures; the frequency at WSYNC and a filter test point failure.

3.3.6 Arb. Autocal Error Codes

Turn the unit on and then press the following sequence of keys; select module, module cal/Test, autocal, start. Once the autocal is complete, after about 30 seconds to a minute, the display should read; cal, date, time and a status number.

Status

Two digits are used to represent the autocal status and the hex value represents 4 bits as seen in figure 3-7.

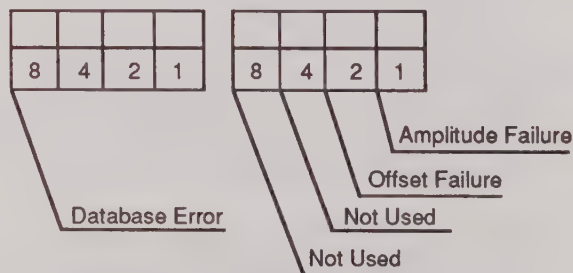


Figure 3-7. Module Autocal Status

3.3.7 GPIB Example Programs for the Arb.

Example 1: This first example is of a consecutive address/data download. The first six lines of the program (10 through 60) will set up the arb. while the remaining lines of code (70 through 160) will download the 120 points of the arbitrary waveform.

```
10 WRITE @70900X:":ARBGEN:AMPL 8;OT ON;
EXEC"! Turns output on
20 WRITE 70900X:":ARBGEN:CLEARMEM;
EXEC"! Clears waveform memory
30 WRITE @70900X:":ARBGEN:WVFMMN
4;WVFMSZ 120;EXEC"! Sets up waveform 4, 120 points
40 EOI OFF
50 TERM IS ""
60 SEPARATOR IS ""
70 WRITE @70900X:":ARBGEN:DL 0"
80 PRINT TIME $
90 FOR Z1 TO 3
100 WRITE @7:":0,100,200,300,400,500,600,700,
800,900,1000,1100,1200,1300,1400,1500,1600,1700,
1800,1900"
110 WRITE @7:":0,—100,—200,—300,—400,
—500,—600,—700,—800,—900,—1000,—1100,—
1200,
—1300,—1400,—1500,—1600,—1700,—1800,
—1900"
120 NEXT Z
```

```
130 TERM IS CHR$(13)&CHR$(10)
140 EOI ON
150 SEPARATOR IS ""
160 WRITE @70900X:":ENDDL;EXEC"
```

Example 2: This is an example of a vectored arbitrary waveform, in which 3 vectors will be sent.

```
10 WRITE @70900X:":ARBGEN:WVFMMN 3;
WVFMSZ 150;EXEC"! Sets up waveform 3
20 WRITE @70900X:":ARBGEN:WVFMD 0;
WVFMDT —2000;WVFMD 35; WVFMDT 2000; VEC-
TOR
30 WRITE @70900X:":ARBGEN:WVFMD
70;WVFMDT —1000;VECTOR"
40 WRITE @70900X:":ARBGEN:WVFMD
149;WVFMDT 1000;VECTOR"
```

Example 3: This last example shows how an in-consecutive address/data download can be achieved by only sending 4 points of a waveform.

```
10 WRITE @70900X:":ARBGEN:WVFMMN 6;
WVFMSZ 20;EXEC"! Sets up waveform 6
20 WRITE @70900X:":ARBGEN:WVFMD 0;
WVFMDT —2000;WVFMD 5;WVFMDT
1000;WVFMD 10;WVFMDT —1000;WVFMD
7;WVFMDT 700;EXEC"
```


MP MASTER



MA35694